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GRAND CENTRAL PALACE, NEW YORK

GENERAL ILLUMINATION COURSE

JANUARY 1930

ASSIGNMENT No. 8

CONTENTS

FLOODLIGHTING



WESTINGHOUSE LAMP COMPANY

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ENGINEERING AND TECHNICAL DATA PREPARED BY THE COMMERCIAL ENGINEERING DEPT. OF THE WESTINGHOUSE LAMP CO., BLOOMFIELD. N. J.

FLOODLIGHTING

An increasing public interest in historic structures and a growing appreciation of beautiful works of architecture has stimulated the use of floodlighting materially in recent years. Commercial organizations, too, have awakened to the possibilities of this dignified and economical means of attracting attention to their places of business.

In planning exterior lighting, the relatively large areas involved, the influence of surroundings and the effect of weather conditions, necessitate lighting equipment and calculations entirely different from those used in interior lighting. The provision of sufficient illumination of suitable quality and of proper direction, with no objectionable brightness or glare, constitutes an individual problem in almost every instance.

The floodlighting of buildings and monuments is largely a question of aesthetics. Uniform, shadowless lighting often defeats the very purpose of the installation. Shadows are essential to relief, and contrasts in intensity or in color can be used advantageously to bring out important details and to suppress others; however, care must be exercised to see that shadows will not be formed so as to distort the appearance of the structure and produce a grotesque result. The aim should be to light the surface so as to preserve and enhance the architectural features

In the case of outdoor bulletin boards or poster panels, the aim should be to provide a uniform intensity of illumination over the entire surface of the display. Outdoor construction work and industrial yards require ample light at working points and thoroughfares. It is important that long, heavy shadows, which present a constant menace to safety, be avoided. This necessitates that light be received from several directions and from projectors located advantageously about the grounds.



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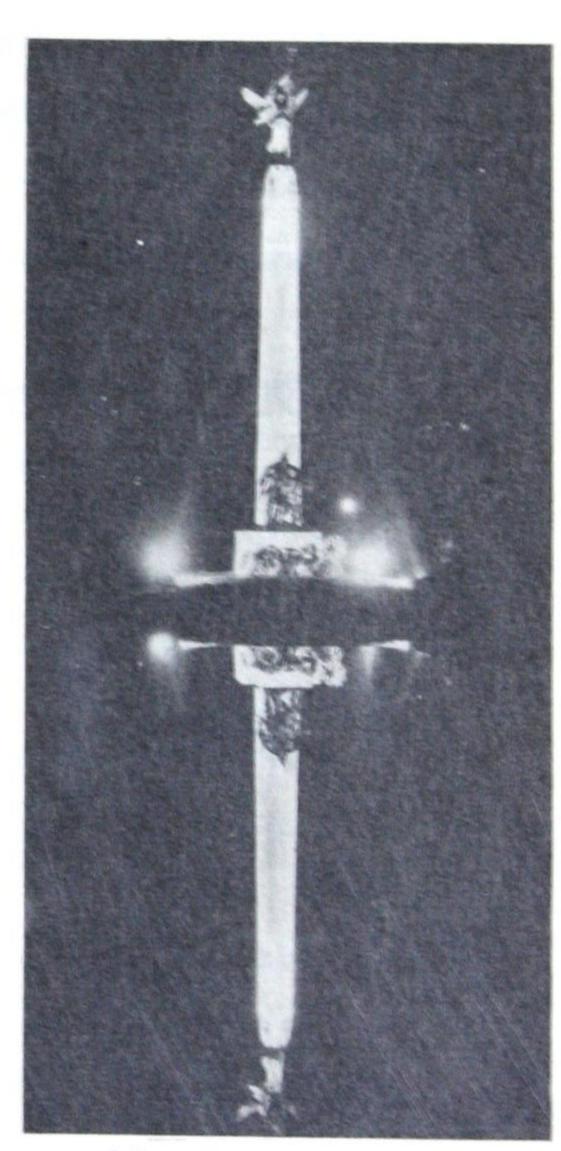




The Edison Building in Philadelphia, with projectors on the various set-backs lighting the upper floors, illustrates the present trend in the floodlighting of modern commercial structures. A total of 262 KW. in clear and colored light is employed.



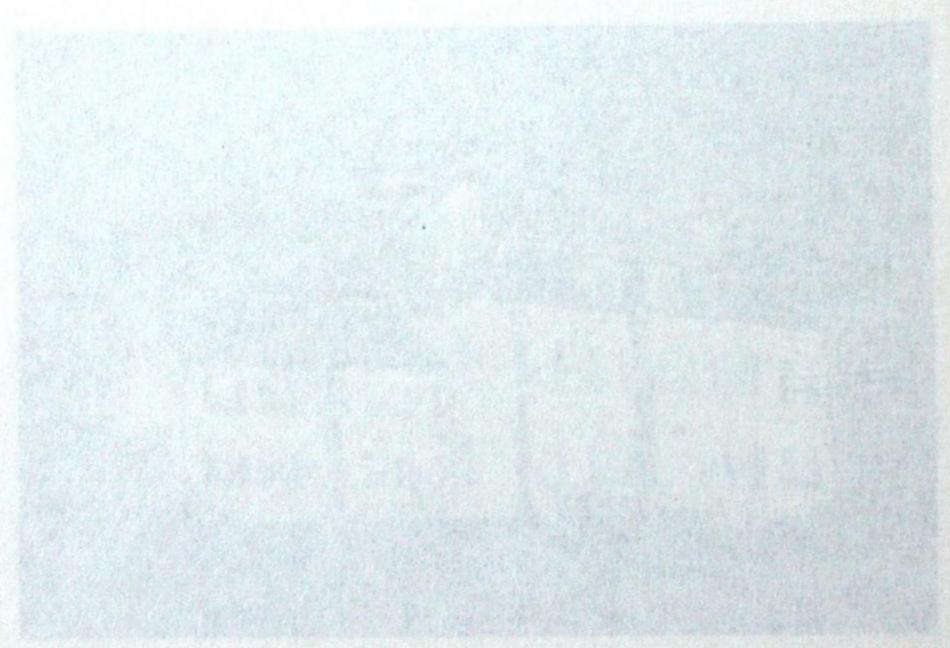
Washington's Headquarters, Morristown, N.J. Five 1000 watt projectors illuminate the front of this historic structure to an intensity of four foot-candles.



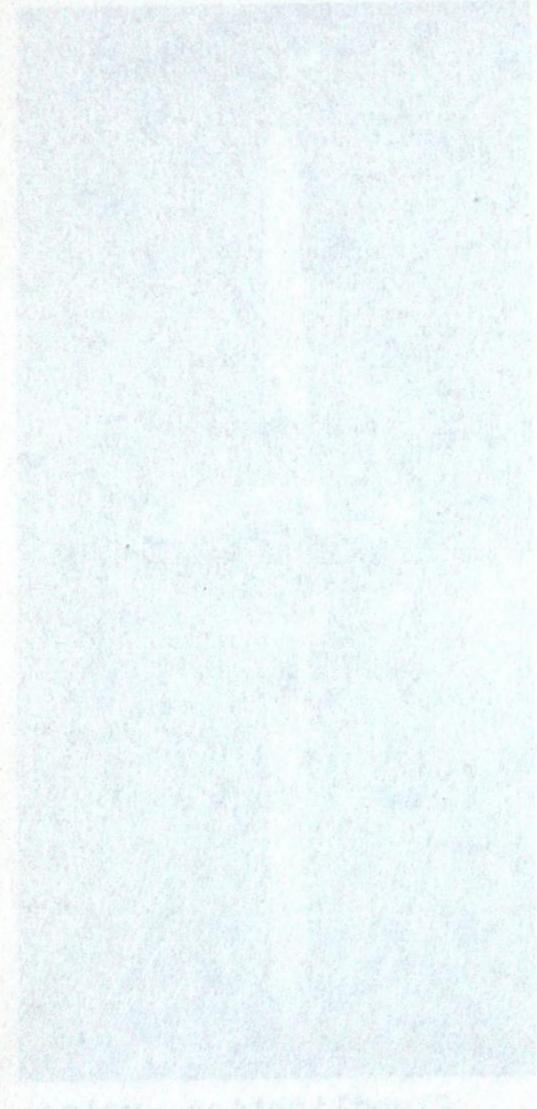
Floodlighting, using twelve 500 watt projectors, enhances the beauty of the Montclair War Memorial and permits its enjoyment at night as by day.

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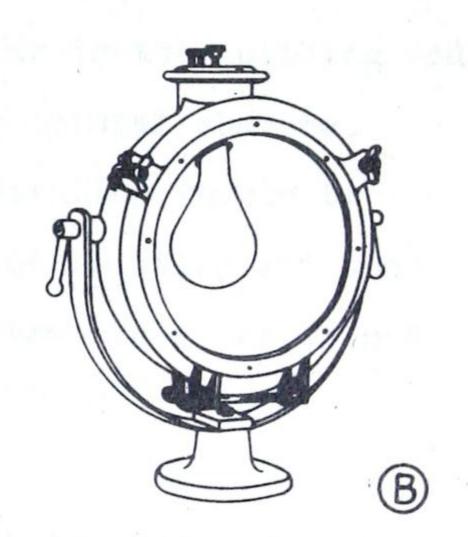
Two general types of floodlighting projectors are available:

(A) those employing the round bulb floodlighting lamps and (B) those designed to use the standard general lighting service lamps. Some of the

latter type can be fitted with adapters which permit the use of either type of lamp. Where a narrow beam (10 to 20 degrees) is desired the 250 or 500 watt round bulb concentrated filament Mazda lamp should be used. For wide beams (20 to 35 degrees) the longer life, less expen-

sive, general lighting service Mazda lamps in the PS bulb, available in 300 to 1500 watts are recommended.

For still wider beams, the stippled or diffusing glass lenses should be used. There are also available spread lenses of ribbed glass for famning out the beam in one plane. Where spill light may be a source of glare or detract from the desired result, louvers of concentric or parallel metal bands should be used.



The increasing demand for color in floodlighting has resulted in the recent development of suitable accessory equipment. Inner lenses of colored glass and also caps fitting over the lamp bulb are now available. In planning installations using color, the transmission factors on page 43 of Assignment 3 should be taken into consideration. While color intensities comparable to those of clear light are unnecessary, allowance should be made for low transmission through screens of the deeper colors and the necessary additional wattage provided.

FLOODLIGHTING DESIGN

The "Lumens in the Beam" method of calculation is now usually employed in designing floodlighting installations. As the name implies, this method is based upon the quantity of light (lumens) directed



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by the projector into the beam. The calculations assume an average intensity over the area to be illuminated. The procedure in designing floodlighting installations by this method is as follows:

1 - Location of Equipment

The location of floodlighting equipment is usually dictated by the physical surroundings. Construction of buildings, topography, area to be lighted and good judgment usually determine the best position for the projectors.

Sometimes a building can be illuminated by placing the projectors on the roofs of other buildings. Where this is possible, best results are usually obtained because the light sources are easier to conceal, the rays strike more nearly perpendicular to the building and the illumination coming from above tends to produce natural shadows.

In plans for new construction, consideration should be given to exterior illumination and provision made for mounting and concealing floodlighting projectors even though their immediate use is not in prospect.

2 - Required Illumination in Foot-Candles

The intensity of illumination required to properly illuminate various types of structures and outdoor areas will be found in the table on page 107 which lists the present standards used in modern practice. The minimum values should be considered as irreducable and those of "Good Practice" employed wherever possible. For spectacular results still higher intensities can be very effectively employed. The table allows for color of surface and brightness of surroundings which obviously must be considered in planning outdoor lighting installations.

3 - Total Amount of Light Required on Object

Having selected the intensity, multiply this foot-candle value by the area in square feet to be illuminated to obtain the total amount of light (total lumens) required on the object.

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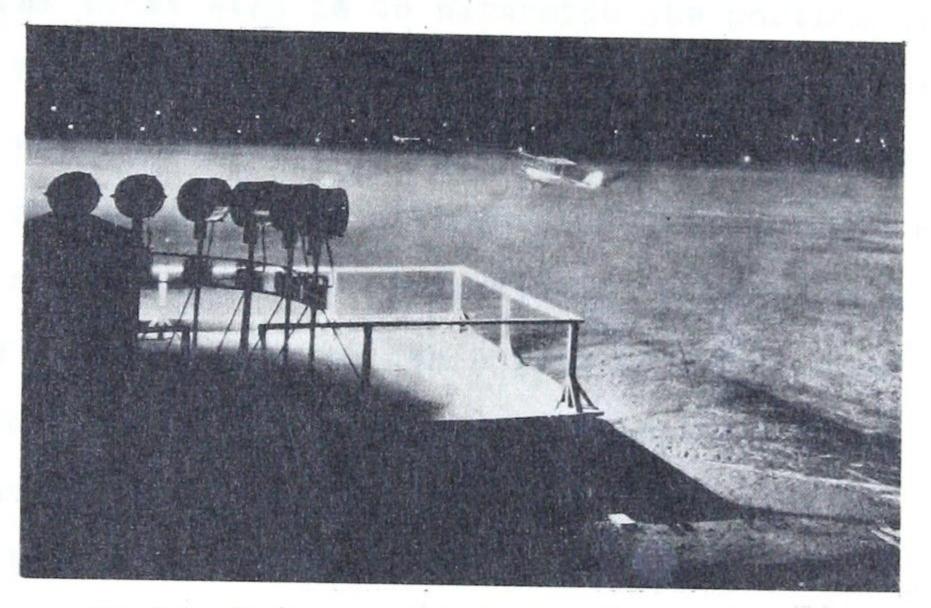
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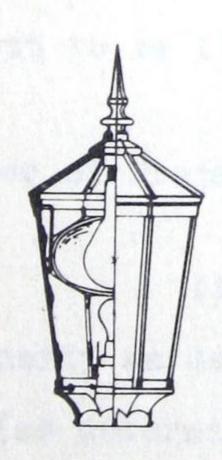


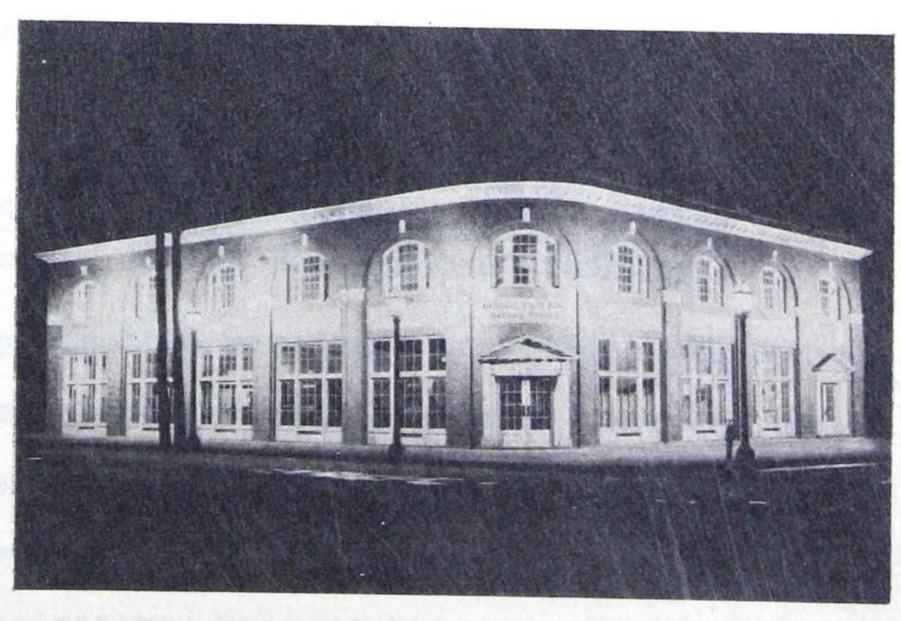


Floodlighting is becoming increasingly popular for advertising industrial plants making nationally known products. The installation illustrated consists of fifty-two 500 watt projectors.

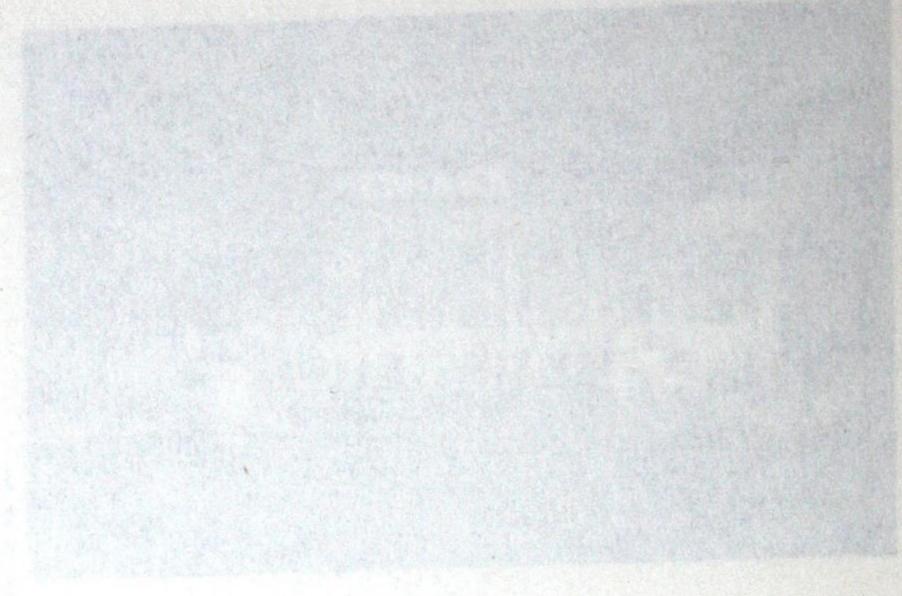


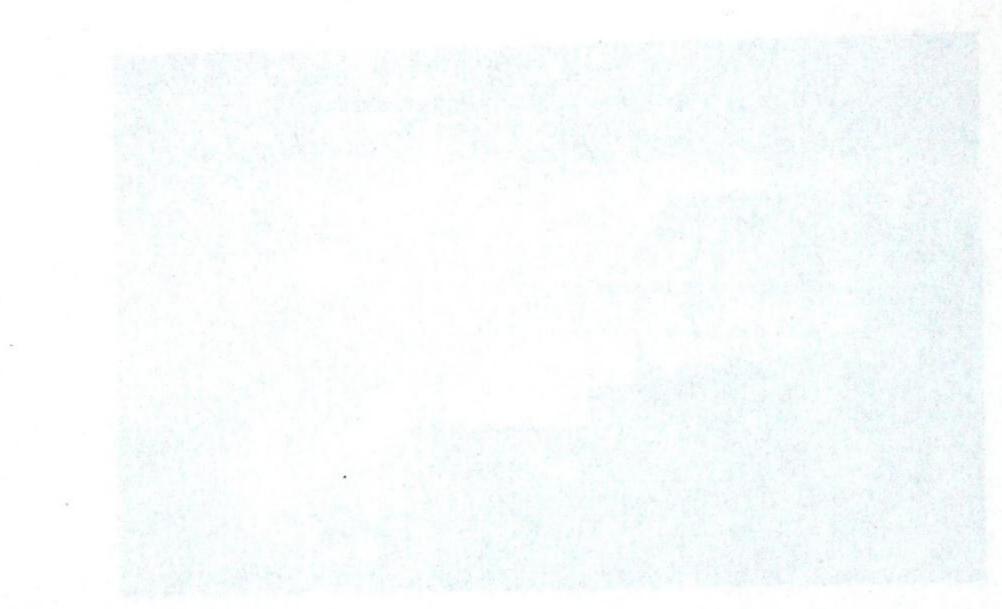
Night flying, which greatly extends the usefulness of the air service, is facilitated by carefully planned illumination of landing fields.





Floodlighting from ornamental street lighting units permits exterior lighting of many buildings otherwise impossible to light because of the difficulty in placing or concealing the floodlight equipment. These units employ a 1000 watt lamp for floodlighting and a 200 watt lamp for illuminating the glass panels of the lantern below the reflector.







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4 - Number of Projectors - Size of Lamps

The total number of projectors and the size of lamps to be used are determined by a combination of two factors: (1) the number of projectors necessary to cover the object completely with no unlighted spots and (2) the total lumens required to illuminate the object or area to the desired intensity. Obviously the most economical solution will be the one which uses as large a lamp as is consistent with proper coverage, since this will reduce lamp, projector, installation, and operating costs.

The first step is to determine the portion of the object covered by the beam of a single projector. On page 108 is shown the characteristic spot produced by a floodlight. The following pages list the dimensions and areas of the ellipses for typical beam spreads at various angles and distances of projection. Making due allowance for portions of the light beam which the object does not intercept and providing sufficient overlap for uniformity of illumination, it is possible to determine the minimum number of projectors required.

The various manufacturers' catalogues or data sheets should be consulted for beam lumens: i.e., the total number of lumens in the beam of the projector. Using these figures in the following formula will give the number of units required to produce the desired intensity on the object to be lighted.

Number of Projectors

Area of Surface in Sq. Ft. to be Lighted x

Required Illumination in Foot-Candles

Lumens in the Beam of One Projector

If the number of projectors necessary to furnish the desired intensity as determined from the above formula is greater than the number (as determined from the table on pages 109 and 110) to completely cover the structure or area, fewer units using larger lamps should be employed. If the number of projectors obtained from the formula are fewer than the number necessary for coverage, the total quantity of light

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obstscieristic spot produced or a thought to the following mapes like the distribute spot produced or a thought to the following mapes like the distribute and areas of the ellipses for will tool case dorsade with various angles and distribute of projections. Asking due allowance for portions of the light bear space also ellevable and projections of the light bear space also ellevable and the possible widths and the restaurant of projections of light has possible to defermant the trainment of projects to projects to purpose.

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would be sufficient but its distribution improper. A greater number of smaller units should be used in such cases.

PRESENT STANDARDS OF FOOT-CANDLE ILLUMINATION FOR OUTDOOR LIGHTING

The first laters. The	Foot-Ca Recomm			Foot-Ca Recomm	
The Part Charles (194)	Good Practice	Mini- mum		Good Practice	Mini- mum
Automobile Parking Spaces	1	0.5	Gasoline Filling Stations:	- 1401.00	
Baseball Diamond (Indoor		No. 1 16 2	At Pumps	15	10
Game)	10	6	Yard and Driveways	13	10
Basket Ball	6	4	Horseshoe Pitching		- 1
Bathing Beaches	1	0.5	Ice Heeken	6	
Bulletins and Poster Panels:	attention to the state of		Ice Hockey	8	5
Bright Surroundings—	1		Loading Docks	3	2
Light Surface	30	20	Lumber Yards	1	0.5
Dark Surface	50	30	Motordromes:		
Dark Surroundings—			Seats	3	2
Light Surface	15	10	Track	15	10
Dark Surface	30	20	Monuments (See Buildi		
Boxing:			Exteriors)	ng	
Seats	3	2			
Ring	80	50	Piers:		
Building:			Freight (See Loading Doc	K3)	
Construction Work	6	4	Passenger	4	2
Excavation	2	1	Playgrounds	4	2
Building Exteriors and Monu-			Polo	8	5
ments-Floodlighted:			Prison Yards	3	3
Bright Surroundings-			Protective-Industrial	3	0.5
Light Surface		6			0.5
Dark Surface	20	15	Quarries	3	2
Dark Surroundings-			Railway Yards:		
Light Surface	6	4	General	0.25	0.15
Dark Surface	12	8	Scale House	3	2
Church Windows (Art Glass).	25-50	15	Roque		A
Circus:			Signs-Painted (See Bullet)	ns)	-
Seats	3	2	Ship Yard Construction	6	4
Arena	10	6	Skating	2	i
Clock Golf	10	6	Storage Yards	1	0.5
Croquet	6	4	Swimming Pools	5	3
Dredging	2	1	Target Shooting	20	15
Drill Fields	3	2	Tennis Court	25-50	15
Flags-Floodlighted	2550	15	Toboggan Slides	2	1
Football:			I rame Unicers	20	10
Practice	0	4	Trap Shooting	15	10
Games	12	8	Volley Ball	15	10

FLOODLIGHT CALCULATION DATA



The beam of a floodlight projector is conical in form. When intercepted by a surface perpendicular to the axis of the beam, the spot of light produced will be circular. Usually, however, the projection is not perpendicular and as a result the area lighted takes on the shape of an ellipse. At greater angles of projection

(0) than shown on the following page, the spot will obviously be a longer ellipse. At grazing angles the intensity of illumination will be



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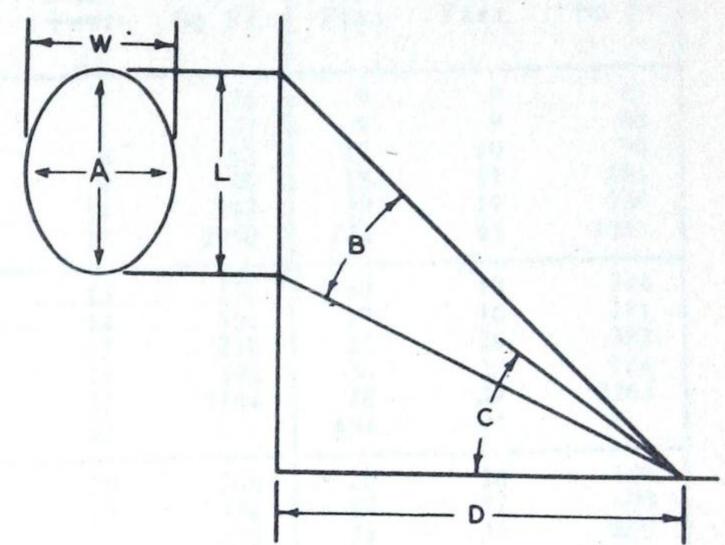


considerably higher on the portion of the lighted area nearest the projector.

The table on the following pages gives the length, width, and area of the illuminated spot for various beam spreads, distances, and angles of projection. In most cases data may be obtained directly from the table. Where beam spreads (B) and angles of projection (C) other than those listed are to be

employed it will be necessary to estimate the corresponding information.

In the illustration to the right the length (L) and width (W) vary directly with the distance (D). The area (A), however, varies with the square of the distance (D). Thus, for any



distance not listed in the table on the following pages, data on the length and width of the ellipse may be obtained by direct proportion from the data given for any other distance with a projector of the same beam spread and the same angle of projection. The area of the ellipse at any given distance will be in proportion to the square of the distance (D) from the point of projection and can be calculated accordingly.

The data in the following table apply to projectors equipped with clear glass lenses which are usually employed for flood-lighting purposes. Projectors with lenses spreading the beam in one direction give smoother illumination and greater coverage for floodlighting structures or areas of relatively narrow proportions.



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FLOODLIGHT CALCULATION DATA

D FT.		B = 10°				B = 15		B = 20°		
	C DEG.	L FEET	W FEET	A Sq. Ft.	l. FEET	W	A Sq. Ft.	L FEET	W FEET	A Sq. F
	0	4	4	15	7	7	34	9	9	61
	15	5	5	17	7	7	37	9	.9	68
25	30	6	5	23	9	8	53	12	10	95 181
25	45	9	9	43 124	13 28	14	297	39	19	566
	15 30 45 60 75	18 73	18	1028	130	14 29	2950	232	45	8251
	0	9	9	59	13	13	135	18	18	244
	15. 30 45	9	9	66	14	14	151	19	18	271
	30	12	10	93	18	15	210	24	20	382
50	45	18	12	172	27	19 27	398 1184	36 78	23 37	724 2263
	75	36 146	18	494 4120	56 259	58	1104	464	91	2200
	0	13	13	135	20	20	308	26	26	549
	15	13	14	149	21	20	336	28	27	609
	15 30	18	15	207	26	23	473	36	31	859
75	45	26 54	19	385	40	28	893	55	34	1629
	60		26	1112	83	41	2660	117	56	5091
	75	220	54	9280	389	87		696	136	1111
	0	18	18	240	26	26 27	543 607	35 38	35 36	977 1082
	15	19	18	264 371	28 35	31	845	48	41	1528
•00	30	23	20 25	685	54	38	1590	73	46	2896
100	45	35 72	35	1987	111	54	4725	156	74	9050
	60 75	292	72	16480	518	116	71	929	181	
des mess	0	26	26	538	40	40	1225	54	54	2280
	15	28	27	598	42	41	1360	57	55	243
	30	35	30	835	53	46	1905	71	61	3430 6515
150	45	53	37	1542	80	57	3570	109	111	
	60 75	107 438	53 107	4460	167 778	82 174		233	278	
		-		0.57				71	71	3900
	0	35	35	957 1067	53 57	53 55	2180 2420	76	73	4330
	15	38 47	36 40	1480	71	61	3390	95	82	609.
200	30	70	50	2750	107	76	6350	146	101	
200	60	143	71	7920	222	108		311	148	
	75	585	143		- 3.4.	232		1000	370	
	0	52	52	2155	79	79	4900	106	106	8770 9720
	15	56	54	2400	85	82	5445 7640	113	109 123	
	30	70	61	3345 6170	106	92		219	152	
300	45	106	75 106		335	163	/	467	223	
	75	215 878	215			348			557	
Construction of the Constr	0	87	87	5930	131	131	Secretary Marines As	176	170	
	15	94	91	6660	141	136		189	182	
	15 30	117	101	9260	177	153	1	238 364	203 254	
500	45	176	124		268	189		778	375	
	60	358	176 538		556	271 580		110	928	

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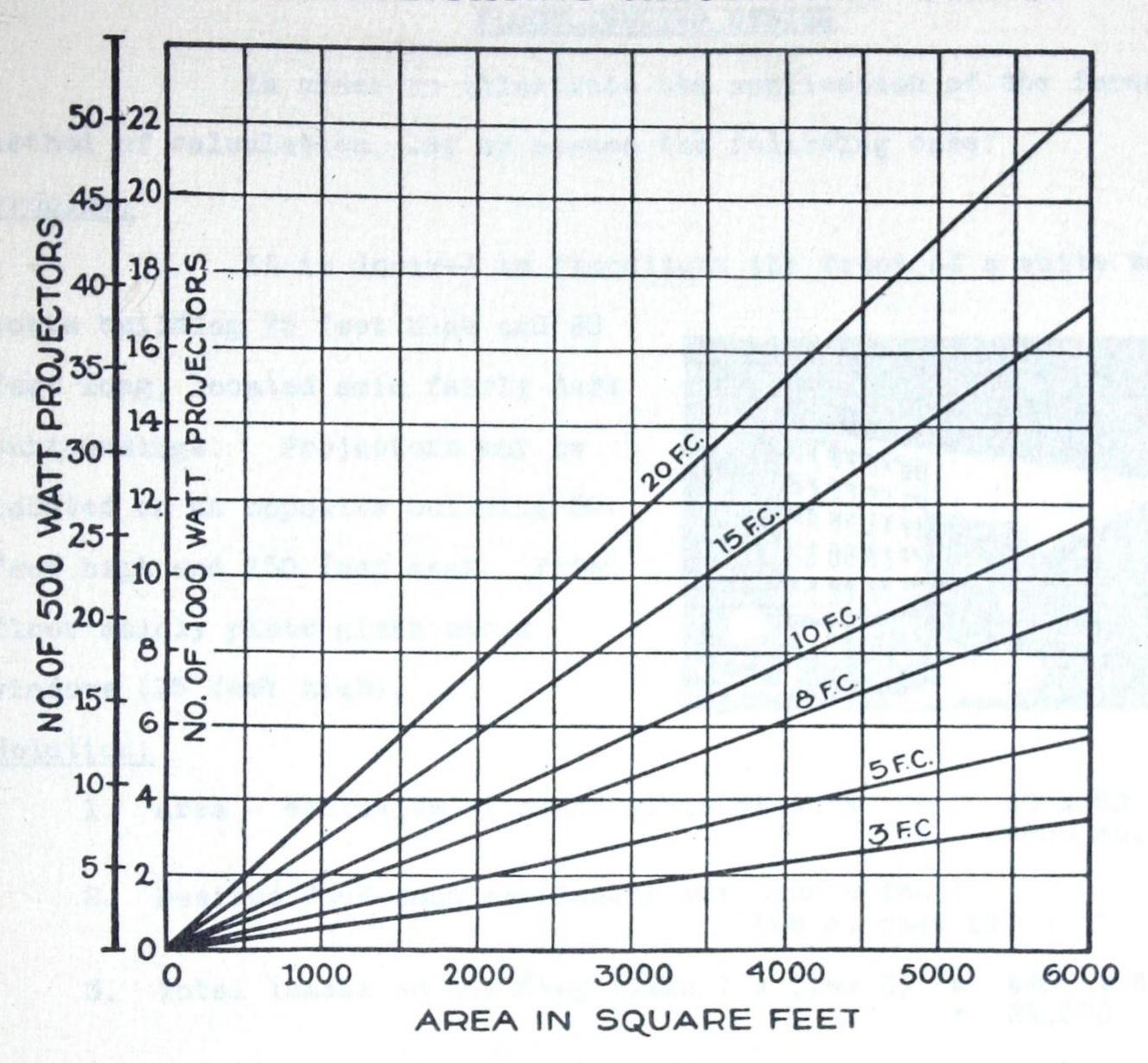
FLOODLIGHT CALCULATION DATA-Cont'd

			B = 25	•		B = 30	•	B = 35°		
D Ft.	C DEG.	l. FEET	W FEET	SQ. FT.	L	W	A SQ. Ft.	L	W	SQ. FT
25	0 15 30 45 60 75	11 12 15 23 52 525	11 12 13 16 24 74	97 108 152 295 984	13 14 18 30 68	13 14 16 20 30	141 158 226 456 1623	16 17 22 35 88	16 16 19 23 37	193 218 319 643 2555
50	0 15 30 45 60 75	22 24 30 47 104	22 23 26 32 48 148	387 429 608 1179 3930	27 29 37 59 137	27 28 31 40 60	564 631 902 1825 6490	32 34 44 70 180	32 33 37 47 75	780 873 1263 2580
75	0 15 30 45 60 75	33 36 45 70 156	33 35 39 48 72 222	866 973 1370 2650 8860	40 43 55 89 205	40 42 47 61 91	1269 1419 2030 4107	47 51 65 105 270	47 49 56 71 113	865 1963 2840 5815
100	0 15 .30 45 60 75	44 48 60 93 208	44 46 52 64 96 296	1540 1723 2440 4720	54 58 73 119 273	54 56 63 81 121	2256 2522 3609 7301	63 68 87 140 359	63 65 74 94 151	3115 3490 5060
150	0 15 30 45 60 75	67 72 90 140 312	67 69 78 97 145 444	3480 3875 5480	80 87 110 174 410	80 84 94 118 183	5070 5670 8140	95 102 131 210 539	95 98 111 141 227	7020 7850
200	0 15 30 45 60 75	89 96 120 186 417	89 92 103 129 193 592	6180 6910 9740	107 116 147 231 547	107 111 125 157 244	9030	126 136 174 280 718	126 131 148 187 302	
300	0 15 30 45 60 75	133 143 180 280 624	133 138 155 193 289 888		161 173 220 347 820	161 167 184 236 366		189 204 261 420	189 196 222 281 453	
600	0 15 30 45 60 75	222 238 300 466	222 230 258 322 482		268 289 366 578	268 278 313 393 608		315 340 435 700	315 327 371 468 754	

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HANDY FLOODLIGHTING CALCULATION CURVES



method, are based upon 26 per cent of the total lamp lumens being directed into the projector beam. This is an average value typical of flood-lighting equipment now commercially available. The curves are intended to serve as a convenient check on calculations or for use in quickly determining the approximate number of floodlighting units necessary to illuminate a given area to a given intensity. The table on pages 109 and 110 should be consulted to insure adequate coverage of the surface by the projector beams.



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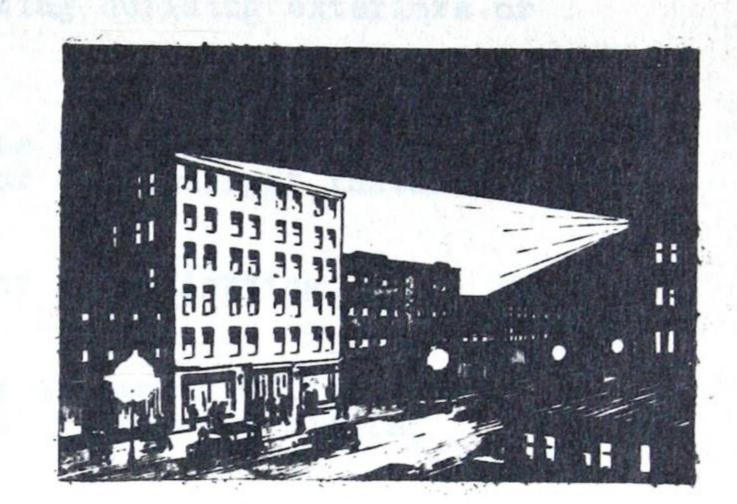
FLOODLIGHTING DESIGN

In order to illustrate the application of the foregoing method of calculation, let us assume the following case:

Problem:

It is desired to floodlight the front of a white terra

cotta building 75 feet high and 80 feet long, located amid fairly dark surroundings. Projectors may be located on an opposite building 50 feet high and 150 feet away. First floor mainly plate glass store windows (15 feet high).



Solution:

- 1. Area exclusive of plate glass windows = 60 x 80 = 4800 sq. ft.
- 3. Total lumens on building (Item 1 x Item 2) = 4800×5 = 24.000
- 4. By plotting the layout to scale, it will be seen that the light rays strike approximately perpendicular to the building surface (angle of projection (c, page 108) equals zero) and from page 110 three projectors, each having a beam spread of 25°, cover the building with generous overlaps.

Referring to one manufacturer's catalogue, the lumens in the beam of a 25° projector using a 1000 watt Mazda C lamp are 5,500. Dividing 24,000 lumens, the total quantity of light required, by 5,500, the lumens in the beam of one projector, gives 4.4. Therefore, five 1000 watt projectors will be necessary to provide the illumination desired.

As only three projectors having a 25° beam are necessary for complete coverage, the building should be uniformly illuminated in view of the additional equipment used to provide the desired intensity.

The installation should, therefore, consist of five 1000 watt projectors having a 25° beam spread and located on the roof of the opposite building.

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QUESTIONS

- 1. A 20 degree floodlight projector is mounted on a tower, 75 feet above the ground. When directed 30 degrees below the horizontal what will be the dimensions of the spot and the area of the ground illuminated?
- 2. What conditions determine the foot-candle intensity to be provided in lighting building exteriors or monuments?
- 3. What determines the size of lamp and the number of projectors necessary for a floodlight installation?
- 4. List ten applications of floodlighting.
- 5. What are the advantages of floodlighting: (a) office building; (b) industrial plants; (c) monuments?

REFERENCES

- Lighting the Sesqui-Centennial International Exposition D. W. Atwater.
 I.E.S. Transactions Vol. 21, pg. 1141, 1926.
- Manual of Lighting Practice for Railroads.
 Association of Railway Electrical Engineers.
- Standard Lighting Cushing.
 H.C. Cushing, Jr., 8 West 40th St., New York City.
- Modern Electrical Illumination Sylvestor & Ritchie.
 Longmans, Green & Co. Ltd., New York City.
 (Floodlighting Chapter 7).
- Illuminating Engineering Practice 1916 Lecture I.E.S. U.P. McGraw-Hill Publishing Co., New York City.
- Report on Committee on Street Lighting I.E.S. Transactions Vol. 22, pg. 1071, 1927.



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